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FORM PTO-1390 (REV 5-93) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **979/50798**

U S APPLICATION NO (if known, see 37 CFR 1.5): 10/019483

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/04085	**6 May 2000**	**29 June 1999**

TITLE OF INVENTION: **BATTERY OF BIPOLAR STACK DESIGN AND METHOD FOR ITS PRODUCTION**

APPLICANT(S) FOR DO/EO/US: **Gabor BENCZUR-UERMOESSY; Marita GESIERICH; Detlef OHMS; and Klaus WIESENER**

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1.	X	This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2.		This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3.	X	This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay Examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4.	X	A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5.	X	A copy of the International Application as filed (35 U.S.C. 371(c)(2)).
		a. ( ) is transmitted herewith (required only if not transmitted by the International Bureau).
		b. (X) has been transmitted by the International Bureau **(PCT/IB/308)**
		c. ( ) is not required, as the application was filed in the United States Receiving Office (RO/US)
6.	X	A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7.	X	Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
		a. (X) are transmitted herewith (required only if not transmitted by the International Bureau).
		b. ( ) have been transmitted by the International Bureau.
		c. ( ) have not been made; however, the time limit for making such amendments has NOT expired.
		d. ( ) have not been made and will not be made.
8.		A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9.	X	An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) **(Unexecuted – 3 pages)**
10.		A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Item 11. to 16. below concern other document(s) or information included:

11.	X	An Information Disclosure Statement under 37 CFR 1.97 and 1.98 **(and International Search Report)**
12.		An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13.	X	A **FIRST** preliminary amendment.
		A **SECOND** or **SUBSEQUENT** preliminary amendment.
14.	X	A substitute specification and marked-up copy thereof.
15.		A change of power of attorney and/or address letter.
16.	X	Other items or information:

a. **1 sheet of Drawings, showing Figures 1-2 (attached to Translation of application)**
b. **International Preliminary Examination Report (IPER)**
c. **PCT/IB/308**

U.S. APPLICATION NO (if known, see 37 CFR 1 5	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
10/019483	PCT/EP00/04085	979/50798

17. [X] The following fees are submitted:		CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO	$ 890.00	$890.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482)	$ 690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)	$ 740.00		
Neither international preliminary examination fee (37 CFR 1.482) nor International search fee (37CFR 1.445(a)(2) paid to USPTO	$ 1000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)	$ 100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =		$890.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		$130.00	

Claims	Number Filed	Number Extra	Rate		
Total Claims	29 - 20 =	9	X $18.00	$162.00	
Independent Claims	4 - 3 =	1	X $84.00	$84.00	
Multiple dependent claims(s) (if applicable)			+ $280.00	$	
TOTAL OF ABOVE CALCULATIONS=				$246.00	
Applicant claims Small Entity Status (See 37 CFR §1.27) [ ] yes [ ] no. Reduction by 1/2 for filing by small entity, if applicable.				$	
SUBTOTAL =				$1,266.00	
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$	
TOTAL NATIONAL FEE =				$1,266.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28,3.31). $40.00 per property +				$	
TOTAL FEE ENCLOSED =				$1,266.00	
				Amount to be: refunded	$
				Charged	$

a. [X] One check in the amount of **$1,266.00** for the filing fee is enclosed

b. [ ] Please charge my Deposit Account No. 05-1323 in the amount of to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees, which may be required, or credit any overpayment to Deposit Account No. 05-1323 **(Attorney Docket No. 979/50798)**. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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James F. McKeown
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NAME
25,406
REGISTRATION NUMBER
December 31, 2001
DATE

Attorney Docket: 979/50798
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: GABOR BENCZUR-UERMOESSY ET AL

Serial No.: TO BE ASSIGNED PCT No.: PCT/EP00/04085

Filed: DECEMBER 31, 2001

Title: BATTERY OF BIPOLAR STACK DESIGN AND METHOD FOR ITS PRODUCTION

PRELIMINARY AMENDMENT

Box PCT **DECEMBER 31, 2001**
Commissioner for Patents
Washington, D.C. 20231

Sir:

Please enter the following amendments to the claims and abstract prior to the examination of the application.

IN THE CLAIMS:

Please cancel claims 1-29.

Please add the following new claims:

30. (New) A Ni/metal hydride battery of bipolar stack design, comprising:

a plurality of subcells disposed in a gastight casing and pressed against each other, each subcell including:

positive and negative electrodes,

a separator disposed between the positive and negative electrodes, and

electrolyte in an amount determined by the porosity of the electrodes and separator;

an electrically conductive wall positioned between two adjacent subcells, the wall separating the electrolytes of the two adjacent subcells and electrically connecting the electrodes of the two adjacent subcells to one another;

a common gas space in which the subcells are disposed; and

two pressure plates functioning as current-discharge poles between which the subcells are disposed, wherein the subcells are permanently pressed against one another in an elastic manner.

31. (New) The battery according to Claim 30 comprising a nickel/metal hydride battery.

32. (New) The battery according to Claim 30, wherein each positive electrode includes a fibrous-structure electrode which is filled with nickel hydroxide active compound.

33. (New) The battery according to Claim 30, wherein a side of each positive electrode facing one of the walls is free of insulating covering layers and/or has an addition which increases the conductivity.

34. (New) The battery according to Claim 30, wherein each of the negative electrodes has a higher capacitance than the corresponding positive electrode.

35. (New) The battery according to Claim 34, wherein the negative capacitance of the negative electrodes is 150 to 250% of the capacitance of the corresponding positive electrode.

36. (New) The battery according to Claim 30, wherein each negative electrode includes a metallic substrate material, wherein the substrate material has a woven fabric and/or an expanded metal and/or a three-dimensional metal structure, and wherein a plastic-bonded compound comprising a hydrogen storage alloy is introduced into the substrate material.

37. (New) The battery according to Claim 36, wherein the compound faces the separator.

38. (New) The battery according to Claim 30, wherein the negative electrodes are pasted asymmetrically.

39. (New) The battery according to Claim 30, wherein each negative electrode has a structure which allows gases to pass through it.

40. (New) The battery according to Claim 30, wherein the subcells form a stack, and the gas space is at the center of the stack.

41. (New) The battery according to Claim 40 further comprising a tie rod disposed in the gas space, the tie rod being used to apply pressure to the stack of subcells.

42. (New) The battery according to Claim 30, wherein at least one sealing ring is disposed between each subcell and the common gas space, the at least one sealing ring preventing the passage of electrolyte and allowing the passage of gas.

43. (New) The battery according to Claim 42, wherein the at least one sealing ring includes porous polytetrafluoroethylene.

44. (New) The battery according to Claim 30, wherein each wall has a tar-like coating material on its edges to prevent the electrolyte from leaking through.

45. (New) The battery according to Claim 30, wherein each wall has a rubber coating on its edges to prevent the electrolyte from leaking through.

46. (New) The battery according to Claim 30, wherein the subcells have a porous felt body, and wherein the felt bodies act as a store for excess electrolyte.

47. (New) The battery according to Claim 30, wherein the electrodes, the separators and the walls are in the form of plates or discs stacked in a common gas space, the negative electrode being coated with the active compound on only one side and/or the positive electrode, on the contact side, being free of active compound, electrical contact being effected only by the individual plates or discs being pressed onto one another.

48. (New) The battery according to Claim 30, wherein the pressure between the components of the individual subcells and the subcells is approximately 10 to 35 N/cm^2.

49. (New) The battery according to Claim 30 further comprising an elastic element provided as a pressure-exerting component for pressing the subcells together.

50. (New) The battery according to Claim 30, wherein the two end plates, which are at a fixed distance from one another, exert a pressing force against the subcells.

51. (New) The battery according to Claim 30, wherein the walls are metallic, and boundary surfaces and/or edges of each wall have a hydrophobic coating that includes one or more bituminous substances of good adhesion.

52. (New) The battery according to Claim 30, wherein the subcells form a stack having a central passage, and wherein the individual subcells are connected to the central passage by porous connecting elements.

53. (New) The battery according to Claim 52, wherein the central passage has a porous tube.

54. (New) The battery according to Claim 52, wherein a porous connecting element and/or a porous tube include porous polytetrafluoroethylene.

55. (New) The battery according to Claim 52, wherein the central passage has a tie rod for relieving the load on the end plates.

56. (New) A method for producing a battery, comprising:

disposing a plurality of subcells in a gastight casing and pressing the subcells against each other, wherein each subcell has positive and negative electrodes and a separator disposed between the electrodes;

impregnating each separator with a predetermined amount of electrolyte;

disposing an electrically conductive wall between two adjacent subcells to separate the electrolytes of the two adjacent subcells and to provide an electrical connection between the electrodes of the two adjacent subcells;

connecting a common gas space to the subcells;

disposing the subcells between two pressure plates functioning as current-discharge poles; and

filling the subcells with electrolyte before the subcells are assembled.

57. (New) A method for producing a battery, comprising:

disposing a plurality of subcells in a gastight casing and pressing the subcells against each other, wherein each subcell has positive and negative electrodes and a separator disposed between the electrodes;

impregnating each separator with a predetermined amount of electrolyte;

disposing an electrically conductive wall between two adjacent subcells to separate the electrolytes of the two adjacent subcells and to provide an electrical connection between the electrodes of the two adjacent subcells;

connecting a common gas space to the subcells;

disposing the subcells between two pressure plates functioning as current-discharge poles;

making each of the positive and negative electrodes, separators and walls in the shape of a plate; and

placing the plates in a stack and pressing the plates together permanently during assembly.

58. (New) A method for producing a battery, comprising:

disposing a plurality of subcells in a gastight casing and pressing the subcells against each other, wherein each subcell has positive and negative electrodes and a separator disposed between the electrodes;

impregnating each separator with a predetermined amount of electrolyte;

disposing an electrically conductive wall between two adjacent subcells to separate the electrolytes of the two adjacent subcells and to provide an electrical connection between the electrodes of the two adjacent subcells;

connecting a common gas space to the subcells;

disposing the subcells between two pressure plates functioning as current-discharge poles;

evacuating the battery and filling the battery by flushing with hydrogen without pressure.

REMARKS

Entry of the amendments to the specification, claims and abstract before examination of the application is respectfully requested. These claims have been amended to remove multiple dependencies/These claims patentably define over the art of record.

If there are any questions regarding this Preliminary Amendment or this application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

Respectfully submitted,

James F. McKeown
Registration No. 25,406
Gary R. Edwards
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Attorney Docket: 979/50798
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: GABOR BENCZUR-UERMOESSY ET AL

Serial No.: TO BE ASSIGNED PCT No.: PCT/EP00/04085

Filed: DECEMBER 31, 2001

Title: BATTERY OF BIPOLAR STACK DESIGN, AND METHOD FOR ITS PRODUCTION

SUBMISSION OF SUBSTITUTE SPECIFICATION

Assistant Commissioner for Patents
Washington, D.C. 20231

December 31, 2001

Sir:

Attached is a Substitute Specification and a marked-up copy of the original specification. I certify that said substitute specification contains no new matter and includes the changes indicated in the marked-up copy of the original specification.

Respectfully submitted,

James F. McKeown
Registration No. 25-406
Gary R. Edwards
Registration No. 31,824
Song Zhu
Registration No. 44,420

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BATTERY OF BIPOLAR STACK DESIGN, AND METHOD FOR ITS PRODUCTION

BACKGROUND AND SUMMARY OF THE INVENTION

The invention relates to a battery for the electrochemical storage of energy in bipolar stack design, and to a method for its production. The invention relates in particular to the structure and method of operation of an electrochemical battery of this type.

Alkaline storage batteries with a type of electrode which has become known as a fibrous-structure framework electrode have been in existence for about 15 years. Electrodes of this type and methods for their production are described, for example, in DE 40 40 017 C2, DE 41 03 546 C2, DE 38 22 197 C1, DE 40 04 106 C2, DE 39 35 368 C1, DE 36 32 351 C1, DE 36 32 352 C1, DE 41 04 865 C1 and DE 42 25 708 C1.

For example, DE 40 04 106 C2 discloses a fibrous structure framework electrode with a high load-bearing capacity, DE 38 22 197 C1, DE 40 40 017 C2 and DE 41 03 546 C2 disclose methods for filling fibrous structure framework electrodes for storage batteries with an active-compound paste.

Conventional storage batteries comprise individual galvanic elements which are composed of individual electrodes of different polarity, the electrolyte, the separator between

the electrodes, the cell or battery casing and the current-carrying and other passive components.

A bipolar stack design differs from the conventional structure in that the connectors between the individual cells and the separate cell casings are dispensed with, and the electrochemical elements, which are referred to as subcells, are connected in series by conductive partitions.

Each subcell has a positive electrode, a separator and a negative electrode, the two electrodes being separated by the electrolyte-filled separator.

Between each pair of subcells there is a connecting wall which is responsible both for electrolytic separation of the subcells and for electrical conduction or contact perpendicular to the surface between the positive and negative electrodes, the current flowing transversely with respect to the electrodes.

For this purpose, the mutually facing surfaces of the connecting wall and the corresponding positive or negative electrode touch one another as a result of the connecting wall making contact with the electrodes over a large area under a pressure which is predetermined but changes slightly in operation. Consequently, there are short paths for the electric current. A structure of this type increases the specific energy, since the high consumption of material for

the current discharge is minimized. This is because the inactive components, such as at least the current discharge lugs for each individual electrode and the pole bridges to which the current discharge lugs are attached, which are otherwise required to conduct electric current, are eliminated.

The diagrammatic bipolar structure and the method of operation of a multicell battery in pile form is described, for example, in the Batterie Lexikon by Hans-Dieter Jaksch, Pflaum-Verlag, Munich, p. 442. By way of example, metal or an electrically conductive polymer is known for the connecting wall. When using metallic connecting walls, nickel plates or nickel-coated steel plates are recommended for alkaline aqueous systems.

Therefore, it is an object of the present invention to provide a battery of bipolar stack design, in which, in operation, uniform loading of the individual subcells is possible. Furthermore, it is intended to provide a method for producing a battery of this type.

According to the invention, a battery includes pairs of positive and negative electrodes, separator layers and connecting walls. The components of the battery are in the form of plates and disks, and electrical contacts are provided only by pressing the individual plates or discs onto one another. The negative electrodes are only coated with the

active material from one side, and the positive electrodes, on the contact side, are being substantially free of active compound. All the subcells have a common gas space but no electrolyte contact.

Therefore, the battery does not have the bipolar electrodes which are known from the literature, but rather comprises individual electrodes as discs or plates which are stacked with separator layers and thin disc-like connecting walls. The electrical contact is formed only as a result of the pressure exerted on the parts. It is expedient to ensure that metallic parts without insulating layers come into contact with one another and the connecting wall is clean. Furthermore, electrical contact can be improved by additions which increase the conductivity.

In particular, the battery according to the invention has a gas space which is common to all the electrodes or cells. The gas connection between the subcells produces, in accordance with the invention, a battery whose individual components are subject to uniform mechanical and electrical loads. Consequently, all the subcells are under the same gas pressure and the same surface pressure. Furthermore, it is possible to compensate for the hydrogen loading and the electrolyte concentration along the individual electrodes. The heat tone of the reactions at the electrodes also effects temperature compensation. In the same sense, the dilution of

the electrolytes of the individual subcells is also compensated as a result of the transfer of water in gaseous form. A further advantage is that only a single pressure-relief/safety valve is required, because of the common gas space.

These features according to the invention are of considerable advantage in particular in the electrochemical nickel/metal hydride system which is preferably used for the operation of the cells, since the negative electrode is in gas equilibrium with the stored reactant hydrogen in the cell and the positive electrode tends to form gas at the charge end. The advantageous balancing of the charges which has been described is limited exclusively to the nickel/metal hydride system on which the invention is based.

It is also possible to optimize the design by using a suitable configuration of the connecting cross sections of the gas leadthroughs.

Advantageous refinements will emerge from the subclaims. The connecting elements may comprise nickel plates. Their thickness is advantageously at most 0.1 mm.

The compressive force to be applied is approximately 10 to 35 N/cm^2. It can be set by means of elastic elements, for example spring elements. However, it can also be set by means of a rigid construction of the battery according to the

invention, in which case end plates which are at a fixed distance from one another are provided.

The ability of the lye to creep along metallic surfaces in the potential field transports and irreversibly shifts the electrolyte between the cells. This would lead to the battery system failing as a result of drying out. Surprisingly, it has emerged that, by applying a hydrophobic coating, which may comprise one or more partial layers, to the edges of the metallic connecting discs, this process is effectively prevented. According to the invention, it is preferable to carry out coating by means of polytetrafluoroethylene or a bituminous substance.

During the first charging of the battery according to the invention, the positive electrode expands as a result of water and alkali being incorporated in the substrate, for example in the layer grid of the nickel hydroxide in the fibrous structure electrode framework. The negative electrode also expands as a result of hydrogen being incorporated in the substrate material. Therefore, it is advantageous if the separators comprise an elastic nonwoven or felt which absorb compressive forces produced during the expansion of the electrodes.

A preferred design of the battery according to the invention uses a central passage, around which the stacks of electrodes, separators, and connecting walls are arranged.

The stacks preferably are connected to the central passage by porous connecting elements. The subcells are in communication with the central passage through the porous connecting element, for example rings or the like made from porous polytetrafluoroethylene. A tie rod for relieving the load on the end plates may be provided in the central passage. The quantity of electrolyte can be regulated by adding liquid, such as water by means of a tube of porous material, e.g. porous polytetrafluoroethylene, which is fitted in the central passage.

The method according to the invention for assembling a battery according to the invention provides for the individual plates to be filled with electrolyte prior to assembly and for the components then to be stacked on top of one another.

The advantages achieved with the invention reside in particular in the fact that it is possible to produce a battery which allows high loads in terms of current combined with a favourable voltage on account of the short current path. The exchange operations in the battery, as well as the electrochemical system, ensure a high use time of the battery.

The method according to the invention is distinguished by the fact that the load-bearing capacity and handling of the battery is considerably improved compared to conventional batteries.

Advantageous refinements will emerge from the subclaims.

Exemplary embodiments of the present invention are described in more detail below with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 diagrammatically depicts the design principle of a storage battery of bipolar stack design, and

Figure 2 shows a diagrammatic sectional illustration of the storage battery from Figure 1 in the form of a round stack.

DETAILED DESCRIPTION OF THE DRAWINGS

The storage battery 1 of stack design, which is diagrammatically depicted in Figure 1, has a housing 2 with a negative pole 3 and a positive pole 4. In the housing 2 there is a stack of individual disc-like or plate-like separators 5, negative electrodes 6, positive electrodes 7 and connecting walls 8. All the discs 5, 6, 7, 8 or subcells formed therefrom have a common gas space 9. The stack is pressed together by spring elements (not shown), for example elastic discs, arranged on the inner wall of the housing 16. Electrical contact is produced only by the pressure. The connecting walls 8 may comprise nickel plates. Their thickness is advantageously at most 0.1 mm.

Figure 2 diagrammatically depicts a longitudinal section through another embodiment 10 of the battery according to the invention. The disc-like or plate-like separators 5, electrodes 6, 7 and connecting walls 8 are now round and have a central passage 12 which is designed as a central bore in the plates or discs 5, 6, 7, 8 and is closed off, for example, using a screw. The stack is enclosed fixedly in a housing 16, two end plates 14, 15 being provided, which are at a fixed distance from one another and provide the pressure. The end plates 14, 15 may be part of the housing 16 or may also be separate and surrounded by the wall of the housing 16. The stack is centred by means of O-rings which are arranged along the wall of the housing 16 and between in each case two connecting walls 8. They may be made from a porous material or of a material which promotes heat transfer between the plates or discs, for example neoprene. The common gas space 9 is formed by the central passage 12. It is advantageously also possible, for example, to top up electrolyte liquid via the central passage 12. The central passage 12 is designed in particular as a porous tube 13 made from polytetrafluoroethylene. As an alternative to the tube 13, it is also possible to use rings of porous material. The poles 3, 4 are situated on the top side and under side, respectively, of the housing 16. The pole plate provided may, for example, be a combination of nickel and honeycomb bodies made from plastic or aluminium with a high flexural strength.

In this design variant with fixed distance between the end plates, the pressure required to make contact is predetermined during construction and rises during the initial loading as a result of the expansion of the electrodes 6, 7. Since the electrodes are in practice not compressible, the separator 5, which preferably is made from an elastic material, acts as the spring.

Naturally, this battery construction is also possible with other geometric cross-sectional shapes, e.g. round, square, rectangular, etc.

All the exemplary embodiments do not in any way restrict the subject matter of the invention.

BATTERY OF BIPOLAR STACK DESIGN, AND METHOD FOR ITS PRODUCTION

BACKGROUND AND SUMMARY OF THE INVENTION

The invention relates to a battery for the electrochemical storage of energy in bipolar stack design, [in accordance with the preamble of Claim 1,]and to a method for its production [in accordance with the preamble of Claim 27]. The invention relates in particular to the structure and method of operation of an electrochemical battery of this type.

Alkaline storage batteries with a type of electrode which has become known as a fibrous-structure framework electrode have been in existence for about 15 years. Electrodes of this type and methods for their production are described, for example, in DE 40 40 017 C2, DE 41 03 546 C2, DE 38 22 197 C1, DE 40 04 106 C2, DE 39 35 368 C1, DE 36 32 351 C1, DE 36 32 352 C1, DE 41 04 865 C1 and DE 42 25 708 C1.

[By way of] For example, DE 40 04 106 C2 [reveals] discloses a fibrous structure framework electrode with a high load-bearing capacity, DE 38 22 197 C1, DE 40 40 017 C2 and DE 41 03 546 C2 [reveal] disclose methods for filling fibrous structure framework electrodes for storage batteries with an active-compound paste.

Conventional storage batteries comprise individual

galvanic elements which are composed of individual electrodes of different polarity, the electrolyte, the separator between the electrodes, the cell or battery casing and the current-carrying and other passive components.

A bipolar stack design differs from the conventional structure in that the connectors between the individual cells and the separate cell casings are dispensed with, and the electrochemical elements, which are referred to as subcells, are connected in series by conductive partitions.

Each subcell has a positive electrode, a separator and a negative electrode, the two electrodes being separated by the electrolyte-filled separator.

Between each pair of subcells there is a connecting wall which is responsible both for electrolytic separation of the subcells and for electrical conduction or contact perpendicular to the surface between the positive and negative electrodes, the current flowing transversely with respect to the electrodes.

For this purpose, the mutually facing surfaces of the connecting wall[, on the one hand,] and the corresponding positive or negative electrode[, on the other hand,] touch one another as a result of the connecting wall making contact with the electrodes over a large area under a pressure which is predetermined but changes slightly in operation. Consequently,

there are short paths for the electric current. A structure of this type increases the specific energy, since the high consumption of material for the current discharge is minimized. This is because the inactive components, such as at least the current discharge lugs for each individual electrode and the pole bridges to which the current discharge lugs are attached, which are otherwise required to conduct electric current, are eliminated.

The diagrammatic bipolar structure and the method of operation of a multicell battery in pile form is described, for example, in the Batterie Lexikon by Hans-Dieter Jaksch, Pflaum-Verlag, Munich, p. 442. By way of example, metal or an electrically conductive polymer is known for the connecting [wall; when] wall. When using metallic connecting walls, nickel plates or nickel-coated steel plates are recommended for alkaline aqueous systems.

Therefore, it is an object of the present invention to provide a battery of bipolar stack design, in which, in operation, uniform loading of the individual subcells is possible. Furthermore, it is intended to provide a method for producing a battery of this type.

[The solution consists in a battery having the features of Claim 1 and in a method having the features of Claim 27.] According to the invention, [it is provided that the

electrodes, the separators and the connecting walls are in the form of plates or discs, that the battery comprises a stack of individual plates or discs, the] a battery includes pairs of positive and negative electrodes, [together with] separator layers and connecting [walls, being stacked] walls. The components of the battery are in the form of plates and disks, and electrical contacts are provided [being formed] only by pressing the individual plates or discs onto one another[,]. [t]The negative electrodes are only [being] coated with the active material from one side, and the positive electrodes, on the contact side, are being substantially free of active compound[, and all]. All the subcells [having] have a common gas space but no electrolyte contact.

Therefore, the battery does not have the bipolar electrodes which are known from the literature, but rather comprises individual electrodes as discs or plates which are stacked with separator layers and thin disc-like connecting walls. The electrical contact is formed only as a result of the pressure exerted on the parts. It is expedient to ensure that metallic parts without insulating layers come into contact with one another and the connecting wall is clean. Furthermore, electrical contact can be improved by additions which increase the conductivity.

In particular, the battery according to the invention has a gas space which is common to all the electrodes or cells.

The gas connection between the subcells produces, in accordance with the invention, a battery whose individual components are subject to uniform mechanical and electrical loads. Consequently, all the subcells are under the same gas pressure and the same surface pressure. Furthermore, it is possible to compensate for the hydrogen loading and the electrolyte concentration along the individual electrodes. The heat tone of the reactions at the electrodes also effects temperature compensation. In the same sense, the dilution of the electrolytes of the individual subcells is also compensated as a result of the transfer of water in gaseous form. A further advantage is that only a single pressure-relief/safety valve is required, [on account] because of the common gas space.

These features according to the invention are of considerable advantage in particular in the electrochemical nickel/metal hydride system which is preferably used for the operation of the cells, since the negative electrode is in gas equilibrium with the stored reactant hydrogen in the cell and the positive electrode tends to form gas at the charge end. The advantageous balancing of the charges which has been described is limited exclusively to the nickel/metal hydride system on which the invention is based.

It is also possible to optimize the design by using a suitable configuration of the connecting cross sections of the

gas leadthroughs.

Advantageous refinements will emerge from the subclaims. The connecting elements may comprise nickel plates. Their thickness is advantageously at most 0.1 mm.

The compressive force to be applied is approximately 10 to 35 N/cm^2. It can be set by means of elastic elements, for example spring elements. However, it can also be set by means of a rigid construction of the battery according to the invention, in which case end plates which are at a fixed distance from one another are provided.

The ability of the lye to creep along metallic surfaces in the potential field transports and irreversibly shifts the electrolyte between the cells. This would lead to the battery system failing as a result of drying out. Surprisingly, it has emerged that, by applying a hydrophobic coating, which may comprise one or more partial layers, to the edges of the metallic connecting discs, this process is effectively prevented. According to the invention, it is preferable to carry out coating by means of polytetrafluoroethylene or a bituminous substance.

During the first charging of the battery according to the invention, the positive electrode expands as a result of water and alkali being incorporated in the substrate, for example in the layer grid of the nickel hydroxide in the fibrous

structure electrode framework. The negative electrode also expands as a result of hydrogen being incorporated in the substrate material. Therefore, it is advantageous if the separators comprise an elastic nonwoven or felt which absorb compressive forces produced during the expansion of the electrodes.

A preferred design of the battery according to the invention uses a central passage, around which the stacks of electrodes, separators, and connecting walls are arranged[, the]. The stacks preferably [being] are connected to the central passage by porous connecting elements. The subcells are in communication with the central passage through the porous connecting element, for example rings or the like made from porous polytetrafluoroethylene. A tie rod for relieving the load on the end plates may be provided in the central passage. The quantity of electrolyte can be regulated by adding liquid, [that is to say] such as water [for example,] by means of a tube of porous material, e.g. porous polytetrafluoroethylene, which is fitted in the central passage.

The method according to the invention for assembling a battery according to the invention provides for the individual plates to be filled with electrolyte prior to assembly and for the components then to be stacked on top of one another.

The advantages achieved with the invention reside in particular in the fact that it is possible to produce a battery which allows high loads in terms of current combined with a favourable voltage on account of the short current path. The exchange operations in the battery, as well as the electrochemical system, ensure a high use time of the battery.

The method according to the invention is distinguished by the fact that the load-bearing capacity and handling of the battery is considerably improved compared to conventional batteries.

Advantageous refinements will emerge from the subclaims.

Exemplary embodiments of the present invention are described in more detail below with reference to the drawings[, in which:].

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 diagrammatically depicts the design principle of a storage battery of bipolar stack design, and

Figure 2 shows a diagrammatic sectional illustration of the storage battery from Figure 1 in the form of a round stack.

DETAILED DESCRIPTION OF THE DRAWINGS

The storage battery 1 of stack design, which is diagrammatically depicted in Figure 1, has a housing 2 with a

negative pole 3 and a positive pole 4. In the housing 2 there is a stack of individual disc-like or plate-like separators 5, negative electrodes 6, positive electrodes 7 and connecting walls 8. All the discs 5, 6, 7, 8 or subcells formed therefrom have a common gas space 9. The stack is pressed together by spring elements (not shown), for example elastic discs, arranged on the inner wall of the housing 16. Electrical contact is produced only by the pressure. The connecting walls 8 may comprise nickel plates. Their thickness is advantageously at most 0.1 mm.

Figure 2 diagrammatically depicts a longitudinal section through another embodiment 10 of the battery according to the invention. The disc-like or plate-like separators 5, electrodes 6, 7 and connecting walls 8 are now round and have a central passage 12 which is designed as a central bore in the plates or discs 5, 6, 7, 8 and is closed off, for example, using a screw. The stack is enclosed fixedly in a housing 16, two end plates 14, 15 being provided, which are at a fixed distance from one another and provide the pressure. The end plates 14, 15 may be part of the housing 16 or may also be separate and surrounded by the wall of the housing 16. The stack is centred by means of O-rings which are arranged along the wall of the housing 16 and between in each case two connecting walls 8. They may [consist of] <u>be made from</u> a porous material or of a material which promotes heat transfer

between the plates or discs, for example neoprene. The common gas space 9 is formed by the central passage 12. It is advantageously also possible, for example, to top up electrolyte liquid via the central passage 12. The central passage 12 is designed in particular as a porous tube 13 made from polytetrafluoroethylene. As an alternative to the tube 13, it is also possible to use rings of porous material. The poles 3, 4 are situated on the top side and under side, respectively, of the housing 16. The pole plate provided may, for example, be a combination of nickel and honeycomb bodies made from plastic or aluminium with a high flexural strength.

In this design variant with fixed distance between the end plates, the pressure required to make contact is predetermined during construction and rises during the initial loading as a result of the expansion of the electrodes 6, 7. Since the electrodes are in practice not compressible, the separator 5, which preferably [consists of] is made from an elastic material, acts as the spring.

Naturally, this battery construction is also possible with other geometric cross-sectional shapes, e.g. round, square, rectangular, etc.

All the exemplary embodiments do not in any way restrict the subject matter of the invention.

1/prts

Translation of PCT/EP00/04085
Attorney Docket: 979/50798

Battery of bipolar stack design, and method for its production

The invention relates to a battery for the electrochemical storage of energy in bipolar stack design, in accordance with the preamble of Claim 1, and to a method for its production in accordance with the preamble of Claim 27.

The invention relates in particular to the structure and method of operation of an electrochemical battery of this type.

Alkaline storage batteries with a type of electrode which has become known as a fibrous-structure framework electrode have been in existence for about 15 years. Electrodes of this type and methods for their production are described, for example, in DE 40 40 017 C2, DE 41 03 546 C2, DE 38 22 197 C1, DE 40 04 106 C2, DE 39 35 368 C1, DE 36 32 351 C1, DE 36 32 352 C1, DE 41 04 865 C1 and DE 42 25 708 C1.

By way of example, DE 40 04 106 C2 reveals a fibrous structure framework electrode with a high load-bearing capacity, DE 38 22 197 C1, DE 40 40 017 C2 and DE 41 03 546 C2 reveal methods for filling fibrous structure framework electrodes for storage batteries with an active-compound paste.

Conventional storage batteries comprise individual galvanic elements which are composed of individual electrodes of different polarity, the electrolyte, the separator between the electrodes, the cell or battery casing and the current-carrying and other passive components.

A bipolar stack design differs from the conventional structure in that the connectors between the individual cells and the separate cell casings are dispensed with, and the electrochemical elements, which are referred to as subcells, are connected in series by conductive partitions.

Each subcell has a positive electrode, a separator and a negative electrode, the two electrodes being separated by the electrolyte-filled separator.

Between each pair of subcells there is a connecting wall which is responsible both for electrolytic separation of the subcells and for electrical conduction or contact perpendicular to the surface between the positive and negative electrodes, the current flowing transversely with respect to the electrodes.

For this purpose, the mutually facing surfaces of the connecting wall, on the one hand, and the corresponding positive or negative electrode, on the other hand, touch one another as a result of the connecting wall making contact with the electrodes over a large area under a pressure which is predetermined but changes slightly in operation. Consequently, there are short paths for the electric current. A structure of this type increases the specific energy, since the high consumption of material for the current discharge is minimized. This is because the inactive components, such as at least the current discharge lugs for each individual electrode and the pole bridges to which the current discharge lugs are attached, which are otherwise required to conduct electric current, are eliminated.

The diagrammatic bipolar structure and the method of operation of a multicell battery in pile form is described, for example, in the Batterie Lexikon by Hans-Dieter Jaksch, Pflaum-Verlag, Munich, p. 442. By way of example, metal or an electrically conductive polymer is known for the connecting wall; when using metallic connecting walls, nickel plates or nickel-coated steel plates are recommended for alkaline aqueous systems.

Therefore, it is an object of the present invention to provide a battery of bipolar stack design, in which, in operation, uniform loading of the individual subcells is possible. Furthermore, it is intended to provide a method for producing a battery of this type.

The solution consists in a battery having the features of Claim 1 and in a method having the features of Claim 27. According to the invention, it is provided that the electrodes, the separators and the connecting walls are in the form of plates or discs, that the battery comprises a stack of individual plates or discs, the pairs of positive and negative electrodes, together with separator layers and connecting walls, being stacked and electrical contact being formed only by pressing the individual plates or discs onto one another, the negative electrode only being coated with the active material from one side, and the positive electrode, on the contact side, being substantially free of active compound, and all the subcells having a common gas space but no electrolyte contact.

Therefore, the battery does not have the bipolar electrodes which are known from the literature, but rather comprises individual electrodes as discs or plates which are stacked with separator layers and thin

disc-like connecting walls. The electrical contact is formed only as a result of the pressure exerted on the parts. It is expedient to ensure that metallic parts without insulating layers come into contact with one another and the connecting wall is clean. Furthermore, electrical contact can be improved by additions which increase the conductivity.

In particular, the battery according to the invention has a gas space which is common to all the electrodes or cells. The gas connection between the subcells produces, in accordance with the invention, a battery whose individual components are subject to uniform mechanical and electrical loads. Consequently, all the subcells are under the same gas pressure and the same surface pressure. Furthermore, it is possible to compensate for the hydrogen loading and the electrolyte concentration along the individual electrodes. The heat tone of the reactions at the electrodes also effects temperature compensation. In the same sense, the dilution of the electrolytes of the individual subcells is also compensated as a result of the transfer of water in gaseous form. A further advantage is that only a single pressure-relief/safety valve is required, on account of the common gas space.

These features according to the invention are of considerable advantage in particular in the electrochemical nickel/metal hydride system which is preferably used for the operation of the cells, since the negative electrode is in gas equilibrium with the stored reactant hydrogen in the cell and the positive electrode tends to form gas at the charge end. The advantageous balancing of the charges which has been described is limited exclusively to the nickel/metal hydride system on which the invention is based.

It is also possible to optimize the design by using a suitable configuration of the connecting cross sections of the gas leadthroughs.

Advantageous refinements will emerge from the subclaims. The connecting elements may comprise nickel plates. Their thickness is advantageously at most 0.1 mm.

The compressive force to be applied is approximately 10 to 35 N/cm^2. It can be set by means of elastic elements, for example spring elements. However, it can also be set by means of a rigid construction of the battery according to the invention, in which case end plates which are at a fixed distance from one another are provided.

The ability of the lye to creep along metallic surfaces in the potential field transports and irreversibly shifts the electrolyte between the cells. This would lead to the battery system failing as a result of drying out. Surprisingly, it has emerged that, by applying a hydrophobic coating, which may comprise one or more partial layers, to the edges of the metallic connecting discs, this process is effectively prevented. According to the invention, it is preferable to carry out coating by means of polytetrafluoroethylene or a bituminous substance.

During the first charging of the battery according to the invention, the positive electrode expands as a result of water and alkali being incorporated in the substrate, for example in the layer grid of the nickel hydroxide in the fibrous structure electrode framework. The negative electrode also expands as a result of

hydrogen being incorporated in the substrate material. Therefore, it is advantageous if the separators comprise an elastic nonwoven or felt which absorb compressive forces produced during the expansion of the electrodes.

A preferred design of the battery according to the invention uses a central passage, around which the stacks of electrodes, separators, and connecting walls are arranged, the stacks preferably being connected to the central passage by porous connecting elements. The subcells are in communication with the central passage through the porous connecting element, for example rings or the like made from porous polytetrafluoroethylene. A tie rod for relieving the load on the end plates may be provided in the central passage. The quantity of electrolyte can be regulated by adding liquid, that is to say water for example, by means of a tube of porous material, e.g. porous polytetrafluoroethylene, which is fitted in the central passage.

The method according to the invention for assembling a battery according to the invention provides for the individual plates to be filled with electrolyte prior to assembly and for the components then to be stacked on top of one another.

The advantages achieved with the invention reside in particular in the fact that it is possible to produce a battery which allows high loads in terms of current combined with a favourable voltage on account of the short current path. The exchange operations in the battery, as well as the electrochemical system, ensure a high use time of the battery.

The method according to the invention is distinguished by the fact that the load-bearing capacity and handling of the battery is considerably improved compared to conventional batteries.

Advantageous refinements will emerge from the subclaims.

Exemplary embodiments of the present invention are described in more detail below with reference to the drawings, in which:

Figure 1 diagrammatically depicts the design principle of a storage battery of bipolar stack design, and

Figure 2 shows a diagrammatic sectional illustration of the storage battery from Figure 1 in the form of a round stack.

The storage battery 1 of stack design, which is diagrammatically depicted in Figure 1, has a housing 2 with a negative pole 3 and a positive pole 4. In the housing 2 there is a stack of individual disc-like or plate-like separators 5, negative electrodes 6, positive electrodes 7 and connecting walls 8. All the discs 5, 6, 7, 8 or subcells formed therefrom have a common gas space 9. The stack is pressed together by spring elements (not shown), for example elastic discs, arranged on the inner wall of the housing 16. Electrical contact is produced only by the pressure. The connecting walls 8 may comprise nickel plates. Their thickness is advantageously at most 0.1 mm.

Figure 2 diagrammatically depicts a longitudinal section through another embodiment 10 of the battery

according to the invention. The disc-like or plate-like separators 5, electrodes 6, 7 and connecting walls 8 are now round and have a central passage 12 which is designed as a central bore in the plates or discs 5, 6, 7, 8 and is closed off, for example, using a screw. The stack is enclosed fixedly in a housing 16, two end plates 14, 15 being provided, which are at a fixed distance from one another and provide the pressure. The end plates 14, 15 may be part of the housing 16 or may also be separate and surrounded by the wall of the housing 16. The stack is centred by means of O-rings which are arranged along the wall of the housing 16 and between in each case two connecting walls 8. They may consist of a porous material or of a material which promotes heat transfer between the plates or discs, for example neoprene. The common gas space 9 is formed by the central passage 12. It is advantageously also possible, for example, to top up electrolyte liquid via the central passage 12. The central passage 12 is designed in particular as a porous tube 13 made from polytetrafluoroethylene. As an alternative to the tube 13, it is also possible to use rings of porous material. The poles 3, 4 are situated on the top side and under side, respectively, of the housing 16. The pole plate provided may, for example, be a combination of nickel and honeycomb bodies made from plastic or aluminium with a high flexural strength.

In this design variant with fixed distance between the end plates, the pressure required to make contact is predetermined during construction and rises during the initial loading as a result of the expansion of the electrodes 6, 7. Since the electrodes are in practice not compressible, the separator 5, which preferably consists of an elastic material, acts as the spring.

Naturally, this battery construction is also possible with other geometric cross-sectional shapes, e.g. round, square, rectangular, etc.

All the exemplary embodiments do not in any way restrict the subject matter of the invention.

Patent Claims

1. Battery of bipolar stack design, having a plurality of subcells accommodated in a gastight casing, a subcell having in each case two electrodes of different polarity and an electrolyte-impregnated separator, and an electrically conductive wall being positioned between electrodes of different polarity belonging to adjacent subcells, which connecting wall electronically connects these electrodes to one another and separates the electrolyte of one subcell from the electrolyte of an adjacent subcell, characterized in that all the subcells are connected to a common gas space (9), in that the electrolyte of a subcell is fixed in a defined quantity in the electrodes (6, 7) and the separator (5), in that the subcells are pressed onto one another by a continuously acting force, and in that the outer walls of the stack, which are designed as pressure plates, form the current-discharge poles (3, 4).

2. Battery according to Claim 1, characterized in that the battery is a nickel/metal hydride battery.

3. Battery according to Claim 1, characterized in that a positive electrode (7) is a fibrous-structure electrode which is filled with nickel hydroxide active compound.

4. Battery according to Claim 1, characterized in that the side of a positive electrode (7) which faces a connecting wall (8) is free of insulating covering layers and/or has an addition which increases the conductivity.

5. Battery according to Claim 1, characterized in that each of the negative electrodes (6) has a higher capacitance than the associated positive electrode (7).

6. Battery according to Claim 5, characterized in that the excess of negative capacitance of the negative electrodes (6) is preferably 50 to 150% of the capacitance of the associated positive electrode (7).

7. Battery according to Claim 1, characterized in that a negative electrode (6) has a metallic substrate material, in that the substrate material has a woven fabric and/or an expanded metal and/or a three-dimensional metal structure, and in that a plastic-bonded compound comprising a hydrogen storage alloy is introduced into the substrate material.

8. Battery according to Claim 1, characterized in that the negative electrodes (6) are pasted asymmetrically.

9. Battery according to Claim 8, characterized in that the compound faces the separator (5).

10. Battery according to Claim 1, characterized in that the negative electrodes (6) have a structure which allows gases to pass through them.

11. Battery according to Claim 1, characterized in that the centre of the stack formed from the subcells is designed as gas space (9).

12. Battery according to Claim 11, characterized in that the central gas space (9) has a tie rod for ensuring that the pressure is exerted.

13. Battery according to Claim 1, characterized in that the subcells are each connected to the common gas space (9) by means of at least one sealing ring, and in that these sealing rings prevent the passage of electrolyte and allow gas exchange with the common gas space (9).

14. Battery according to Claim 13, characterized in that the sealing rings consist of porous polytetrafluoroethylene.

15. Battery according to Claim 1, characterized in that the connecting walls (8), on their edges, have a tar-like coating material which prevents the electrolyte from creeping over.

16. Battery according to Claims 1 and 13, characterized in that the connecting walls (8), on their edges, have a rubber coating which prevents the electrolyte from creeping over.

17. Battery according to Claim 1, characterized in that the subcells have a porous felt body, and in that the felt bodies act as a store for excess electrolyte.

18. Battery according to Claim 1, characterized in that the electrodes (6, 7), the separators (5) and the connecting walls (8) are each in the form of individual plates or discs, in that the battery (1, 10) comprises a stack of these individual plates or discs, the pairs or positive (7) and negative electrodes (6) being stack, together with separator layers (5) and connecting walls (8), in a common gas space (9), the negative electrode (6) being coated with the active compound from only one side and/or the positive electrode (7), on the contact side, being free of active compound, electrical contact being effected only by the individual plates or discs being pressed onto one another.

19. Battery according to Claim 1, characterized in that the pressure between the components of the individual subcells and the subcells themselves is approximately 10 to 35 N/cm^2.

20. Battery according to Claim 1, characterized in that an elastic element is provided as pressure-exerting component for providing the pressure.

21. Battery according to Claim 1, characterized in that two end plates (14, 15), which are at a fixed distance from one another, are provided as pressure-exerting component for providing the pressure.

22. Battery according to Claim 1, characterized in that the boundary surfaces and/or edges of the metallic connecting wall (8) have a hydrophobic coating, preferably comprising one or more bituminous substances of good adhesion.

23. Battery according to Claim 1, characterized in that the stack which is formed from the subcells has a central passage (12), and in that the individual subcells are connected to the central passage (12) by porous connecting elements.

24. Battery according to Claim 23, characterized in that the central passage (12) has a porous tube (13).

25. Battery according to one of Claims 23 or 24, characterized in that a porous connecting element and/or a porous tube (13) consists of porous polytetrafluoroethylene.

26. Battery according to Claim 23, characterized in that the central passage (12) has a tie rod for relieving the load on the end plates (14, 15).

27. Method for producing a battery according to one of Claims 1 to 26, characterized in that the components are filled with electrolyte before being assembled.

28. Method for producing a battery according to one of Claims 1 to 26, characterized in that the individual plates are stack on top of one another and the stack is permanently pressed together during assembly.

29. Method for producing a battery according to one of Claims 1 to 26, characterized in that before it is put into use, the battery is evacuated and/or filled by flushing with hydrogen without pressure.

Abstract

The invention relates to a battery of bipolar stack design, having a plurality of subcells. The battery, the subcells of which comprise in each case two electrodes of different polarity and an electrolyte-impregnated separator, are electronically connected via an electrically conductive connecting wall between them. All the subcells are connected to a common gas space. The connecting walls between the subcells produce the electrical contact and, at the same time, exclude any electrolytic connection. The electrolyte is fixed in a limited quantity in the electrodes and the separator. The subcells are pressed together by a continuously acting force. The current is discharged on the outer walls of the casing, which are designed as pressure plates.

1/1

Figure 1

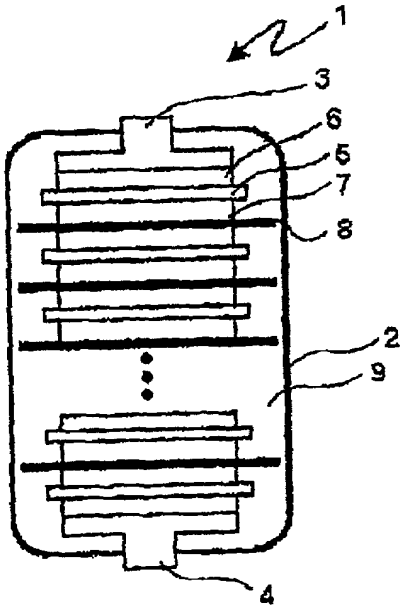
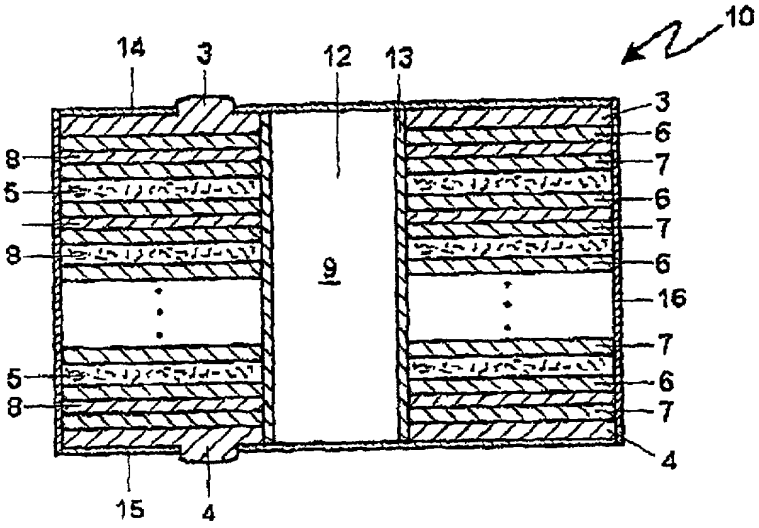


Figure 2



COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (includes Reference to PCT International Applications)	ATTORNEY'S DOCKET NUMBER **979/50798**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

BATTERY OF BIPOLAR STACK DESIGN AND METHOD FOR ITS PRODUCTION

the specification of which (check only one item below):

[ ] is attached hereto.

[ ] was filed as United States application
Serial No.
on
And was amended
on _____ (if applicable).

[ ] was filed as PCT international application
Number **PCT/EP00/04085**
on **6 May 2000**
and was amended under PCT Article 19
on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations. §1.56(a).

I hereby claim foreign priority benefits under Title 35, United State Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT indicate PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
Germany	199 29 950.1	29 June 1999	[X] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No

Combined Declaration For Patent Application and Power of Attorney (Continued) (includes Reference to PCT international Applications	ATTORNEY'S DOCKET NUMBER **979/50798**

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national of PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120

U.S. APPLICATIONS		STATUS *(Check one)*		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (IF ANY)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)

Herbert I. Cantor, Reg. No. 24,392; James F. McKeown, Reg. No. 25,406; Donald D. Evenson, Reg. No. 26,160; Joseph D. Evans, Reg. No. 26,269; Gary R. Edwards, Reg. No. 31,824; and Jeffrey D. Sanok, Reg. No. 32,169

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true: and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE April 1, 2002	Date April 14, 2002	DATE April 7, 2002

Combined Declaration For Patent Application and Power of Attorney (Continued) (includes Reference to PCT international Applications	ATTORNEY'S DOCKET NUMBER **979/50798**

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national of PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120

U.S. APPLICATIONS		STATUS *(Check one)*		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (IF ANY)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)

Herbert I. Cantor, Reg. No. 24,392; James F. McKeown, Reg. No. 25,406; Donald D. Evenson, Reg. No. 26,160; Joseph D. Evans, Reg. No. 26,269; Gary R. Edwards, Reg. No. 31,824; and Jeffrey D. Sanok, Reg. No. 32,169

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	RESIDENCE & CITIZENSHIP	CITY Dresden	STATE OR FOREIGN COUNTRY Germany	COUNTRY OF CITIZENSHIP Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS Thomas-Man-Strasse 44	CITY Dresden	STATE & ZIP CODE/COUNTRY D-01219 Germany
205	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
206	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true: and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206
DATE April 20, 2002	Date	DATE